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Original Article

Automatic Health Care Unit

Zulqarnain[1], Obaid Ashraf[1], Malka Alia[2]

1. Sir Syed University of Engineering and Technology
2. University of Karachi

Corresponding author:Zulqarnain.sheikh92@gmail.com

Abstract

This paper reflects on a novel concept of automation in the health care sector. The idea is to design an automatic system (AHCU) capable of performing remote physical examination with blood glucose estimation, pulse rate measurement, body mass measurement and body temperature measurement. The medical automatic system is consisted of a built-in dispenser to provide front-desk medicines to patient and also prescription in hard copy as well as in soft copy. In the Karachi city, we conducted first focus groups with doctors in order to identify how the remote medical diagnostician system is assessed and conceptualized regarding the examination procedures (activities), communication issues, and the visualization of needed information. The AHCU was found to be very reliable and efficient machine to provide front-desk monitoring, prescription and medication. It takes approximately 20 seconds to examine glucose level in blood, 10 seconds for fever measurement, 5 seconds in pulse rate measurement and 7 seconds for weight measuring. For providing medicines, it takes maximum 60 seconds in all cases. Based on the findings, we has reflected on the technology assessment, i.e., if remote medical services can be a suitable possibility for rural areas where the availability of doctors with various specializations is often a problem, as well as necessities for this novel type of medical treatment from a doctor's point of view (i.e., identified aspects increasing acceptance and adoption by users of the system).

Keywords

AHCU, Automated Health, Autonomous Medical Unit, Basic Medical Facility, Front Desk Medical Unit, Health Facility in Rural Areas

Introduction

Many countries have taken different approaches to ensure the quality and improving standards in health care services (Ferlie, et al, 2001). In some countries, quality assurance in health care has been left to professional organizations and provider associations with little specific regulation. Globally, governments are searching for ways to improve equity, efficiency, effectiveness, and responsiveness of their health systems (Kutzin, et al, 1995). The WHO World Health Report identifies many countries that fall short of their performance potential (Atun, 2004). There is no agreement on optimum structures, content, and ways to deliver cost-effective services to achieve health gain for the population. A Health Care Unit delivers quality services to all people, when and where they need them. The motive of our research is to provide a basic health facility to a common man. An Automatic Health Care Unit (AHCU) is a form of electronic medical care unit that uses state of the art technology to provide diagnosis reports and a care service. An AHCU may also be referred to as a Tele-HCU. It can be easily accessed and operated. It will be cost effective. AHCU will provide basic clinical solution. 24-hours-a-day by the help of electronic healthcare desk. Automatic Health Care Unit will include basic test incentives and will be used to provide first hand medicines to the patients, free of cost. The scope of the project is that it diagnoses a person, prints diagnostic reports and parcels out medicines so that a person can pass a day without consulting any doctors, in-short, the AHCU will facilitate patient and provide urgent care services. Glucometer, weight sensor, infra-red thermometer, PulseOxy meter, keypad, LCD display and other gadgets are connected in AHCU, and care-unit is connected by data lines and printing machine that will print out the diagnostic report via thermal printer with real-time patient data around the clock. The question arises, why we chose ‘an automatic heath care unit’ as our final year project. The basic challenges and the problems faced by the people in our country is that they can’t get better health incentives as they have or the hospitals and the medical institutions that have the facilities charge a large amount of money (Waddington, et al, 1989) that they can’t efforts to spend, thus we have taken this challenge that we can confined the basic test facilities into a single unit so that every person could reach them easily. Though, it’s the basic need of the human being and we should have to work for the humanity, owing to the fact that, nothing is precious than human race (Singh, et al, 1996). The AHCU can be installed in remote areas where doctors and medical aid aren’t easily available. As we know that our country is in a critical situation where the people could not get a better incentives regarding the social, economic and health sectors as they have been able

to, so our motivation about this project is to provide a common man a basic health facility for them so that they can easily access and operate it without of much cost as they have to spend.

Methodology

Project integrant

- The major project integrants, components or gadgets are;
- IR thermometer (Brand name: Microlife FR1DL1)
- Glucometer (Brand name: EasyMax R13N)
- Weight Machine (EKS-9616)
- PulseOxy meter
- Thermal printer (Brand name: Black Copper BC-85AC)
- Keypad (3x4 flexible matrix keypad)
- Medicine dispenser
- LCD display (LM12864DDW)
- Animation LCD (5" x 7")
- H-bridges
- Power supply
- PIC16F877A development board, the module is being used in the system.
- PIC CSS compiler software
- Proteus, the system modeling and circuit simulation application

The most prominent feature of our project is that the electronic gadgets are being used in our AHCU, though; our project is solely 'electronic' based. The AHCU will provide an aid to the people who don't want to wait in long queues for the basic medical checkup and will also help the people who can't afford costly medical inspection. AHCU can be installed in the places where there are less or no medical testing facility such as remote areas, villages and low population areas. It can also be installed in the Hospitals to help out people waiting in the long queues. It can also be placed in the streets or neighborhoods so that anyone can examine his/her medical status without going to a Hospital or referring to any doctor.

In Automatic Health and Care Unit (AHCU), only one gadget is turned-on at a time. To achieve such ordered and arranged sequence, a relay-based circuitry is used to turn these gadgets ON and OFF one after another. After starting-up of AHCU, the data of all gadgets are passed-on to the central controlling unit which is baed on PIC16F877A. The controller saves all these values (coming from the gadgets in a specific sequence) into its buffers. After storing all these values, controller performs analysis of the data values to determine the medical situation of the patient and to decide what medicine(s) should be given. For example, if the patient has temperature of 101°F and the patient weighs above 80Kg then he/she should take Panadol with dosage 2+0+2 (i.e. two in the morning and 2 in night). Another example would be if the patient has high glucose i.e. glucose above 125-mg/dl while other symptoms are normal. In such case, patient should take Glucophage and Gatral. After making such decisions, controller passes a signal to the medical dispenser circuitry to drop-out the medicine(s). The dispenser circuitry is based on H-bridges to rotate the DC motors to control primary and secondary disks. Primary disk contains six test-tubes with six different medicines. Each test tube is of fixed distance from each other. This fixed distance between test tubes provides the advantage of having fixed time delay to reach different test tube. For example, if the delay between test tubes is 2 seconds, then in order to reach third test tube (having the medicine need to be given to the password), the primary motors will be needed to rotate for about 6 seconds. After having the medicine on the patch which is used to slide medicines out of the AHCU, dispenser circuitry signals secondary motors to drop medicines from dispenser outlet so that it can slide-out of the AHCU. Alongside of medicine dispenser, controller also signals thermal printer to print the prescription and passes the data to the printer over the serial line with 9600 baud rate. The data comprises of name(s) of medicine, dosage and some instructions. Thermal printer works on EPSON ESC/POS protocol. Along the whole process, controller also updates the GLCD and instruction screen to guide the patient throughout the diagnosis process.

Results

The AHCU is very reliable and efficient machine for monitoring patients to provide them front-desk monitoring, providing prescription and medicines for up to three days. The AHCU take very less time to examine a patient, performing tests and providing him/her medicines. It takes approximately 15 to 20 seconds in performing the blood glucose level test either fasting blood sugar or random blood sugar (FBS/RBS) of a patient via Digital Blood Glucose Level measuring device (Glucometer) and can compare values according to international diagnostic criteria of diabetes(Cohen, S. P. 1984). Around 5 to 8 seconds in measuring the body mass of a person via load sensor. Approximately 10 seconds in measuring the body temperature (fever) of a patient without even touching him/her via infrared based digital thermometer. The average time taken by each process is described below in the table.

Table 3(1): Describing Time required in completion of several processes

Parameters	Testing time (sec)	Prescription time (second)	Medication time (second)	Time for single patient (Sec)
Glucose	17.5 ± 2.5	25	60	102.5 ± 2.5
Fever	10	20	35	65
Weight	6.5 ± 1.5	--	--	6.5 ± 1.5
Glucose + Weight	17.5 ± 2.5	25	60	102.5 ± 2.5
Fever + Weight	10	20	35	65
Glucose + Fever	27.5 ± 2.5	45	95	167.5 ± 2.5

Numerical Values are in Mean ± SEM

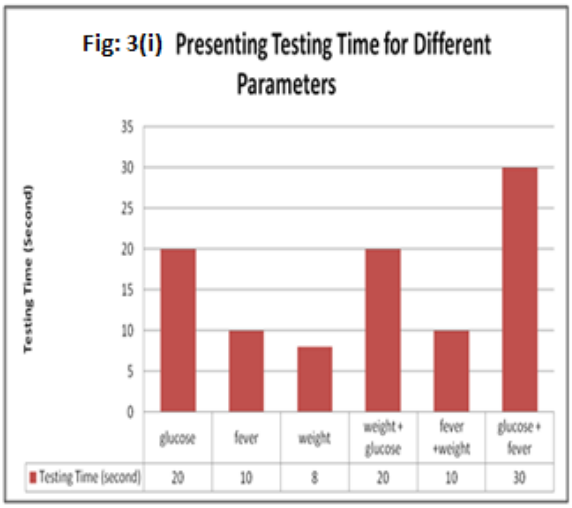


Fig: 3(i) Presenting Testing Time for Different Parameters

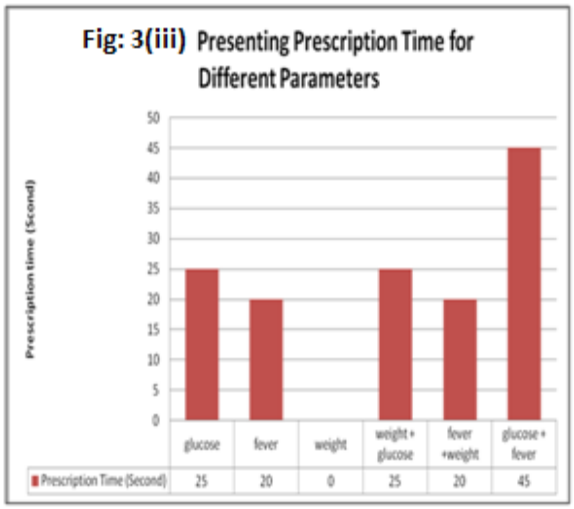


Fig: 3(iii) Presenting Prescription Time for Different Parameters

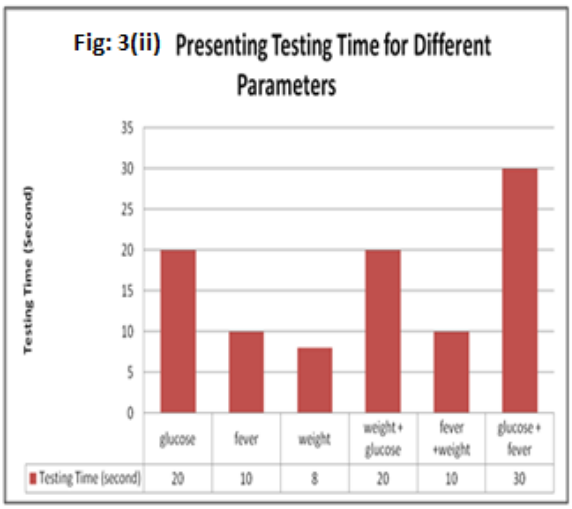


Fig: 3(ii) Presenting Testing Time for Different Parameters

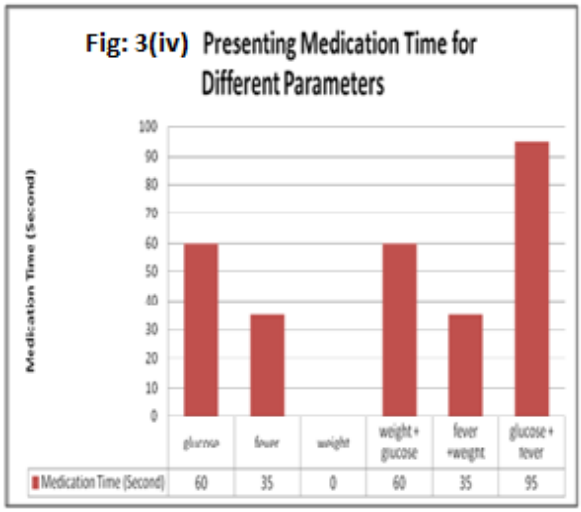
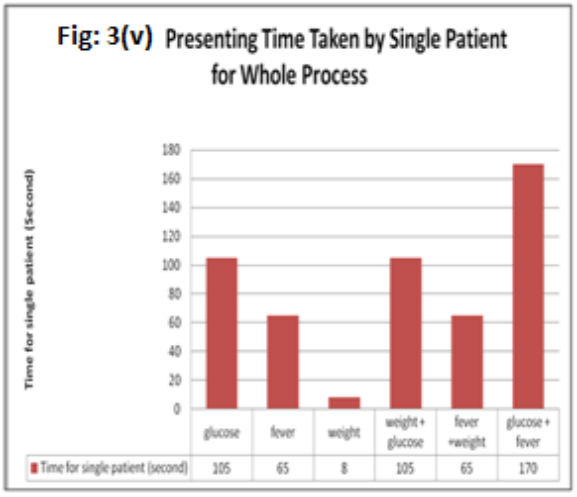


Fig: 3(iv) Presenting Medication Time for Different Parameters



Discussion

The fundamental objective for our research was to create a basic front-desk health facility for the betterment of a common man and to implement it in remote areas where people could not get easy health facilities. To improve the accuracy in testing, safety in sampling, speed of testing and making results and efficiency of modern medication dispensing and to provide a basic front-desk health facility to a common man to fulfill his/her fundamental health problems we designed this project and it has a great significance in the electronics as well as in health sector. As we are third world country (Walton, et al, 1990) (Azhar, S., et al, 2009). (Kingma, M. 2001). Hence we have been facing a great problem in medical sector (Azhar, S., et al, 2009). (Kingma, M. 2001). (Channa, et al, 2011). The ratio of diseases is increasing dangerously day by day and we even do not have basic health facilities and necessities (Islam, A. 2002) in general not even cure for fever in remote areas (Channa, et al, 2011).Our country has been facing great problems like lacking of medicine availability (Azhar, S., et al, 2009). in remote areas even in urban areas medicines are not available at night time, Lacking of doctors not even in remote areas but in several urban areas there is lack of good and experienced doctors (Islam, A. 2002), quakes are usually found in middle class locality of urban areas (Channa, et al, 2011), unpunctuality of doctors has been observed in different hospitals especially in government-financed hospitals. Private hospitals have punctual doctors but they are highly paid, even they charge 500PKR minimum to test blood glucose level and for only consultancy of fever they charge minimum 350 to 500 PKR hence they are highly paid and out of reach of common people. We have Strikes on regular basis sometimes because of political situation sometimes because of religious problems sometimes because of salary issue of doctors sometimes because of other big or small issues, less availability of medicines at night in urban areas and in remote areas dispensaries are very far from villages and towns hence it is very difficult to get medicine at earliest even in some rural areas of Sind and Baluchistan there is not even a single dispensary or medical store from where people can buy basic front-desk medicine.

Our Automatic Health Care Unit (AHCU) has the facility of on hand testing for free, prescription for medicines, providing medicine for up to three days and disclaimer to visit nearest doctor or hospital in order to make sure that there is no risk to the life of the patient.

The built in dispenser provides medicine for free as there is not any kind of chain-business in which every whole-seller, supplier and retailer etc get there profit and the medicine become expensive. In AHCU the medicine will directly be provided from the pharmaceutical industry and is financed by some NGO or government or some welfare society so that it will be free for every common man.

Currently we have included basic features in the AHCU likewise we have included Blood Glucose Testing via Digital Blood Glucose Tester (Glucometer), Human temperature testing (fever testing) without even touching the person via Infrared based digital thermometer, mass measurement via load cell placed in front of the AHCU, Prescribing medicines and disclaimer to visit nearest doctor or hospital via Thermal Printer, providing medicines after comparing the test result values according to international diagnostic criteria for up to three days via Built-in Dispenser. The load cell is shielded or covered to make sure that the harsh environment, sewerage water, rain water or some other kind of environmental problem may not harm the load cell.

Strength of our AHCU for future is Blood Pressure testing, heart rate or pulse rate measurement, diarrhea investigation, flue investigation, BMI measurement, dengue testing, malaria testing, cough testing etc. The machine is open to modify and upgrade. Since there is no limit of engineering advancement for Engineers hence there is no limit for up gradation of the AHCU. In future more and more options and advancements can be included in the machine to make it more advance even may be able to replace a doctor.

During the designing and implementation we faced several small and big issues and problems. Likewise first of all we encountered by mechanical designing problems, as we are students of Electronic Engineering, we do not have much knowledge regarding Mechanical Engineering so it was very difficult for us to design the Mechanical part of the project but we continued to do the hard work and worked day and night, searched over internet, tried different designs, enhanced our assumptions and

finally we got reached to the level and designed the required design. After designing when the time of implementation came, the biggest issue was of availability of components such as required type of geared rod, required type of gears, etc. When we found the things next issue was of material, the things present in the market was of such material that was not compatible with our design so we kept surveying and finally after a long hard work we got the required things of compatible material. Next big issue was of interfacing gadgets with a single micro controller. We tried every possible way to interface the gadgets but the issue aroused was that the micro controllers inside the gadgets were protected, we tried to jail break it, tried to read the coding scheme and then interfacing it with our micro controller or EEPROM but whenever we connected any device in order to interface, the micro controller of gadget stopped to work, several other ways were also tried but all went in vain.

When nothing worked the final thing was manual input of reading so that the patient could get his/her medicine and could have a front-desk solution. For developers there is an option to interface the devices with a single micro controller and bypass the manual input of readings by automatic input of reading via some code. Currently the exclusion criteria in our project is that except basic testing as described above all types of special cases and systematic diseases like Ocular diseases, Cardiac diseases, Neuromuscular diseases, Genital Diseases and Nephrological diseases etc are excluded. In the light of above explanation it can be said that the project which we are designing will create a new era in the remote dispensing sector and will change the dimension of our health sector to overcome at least the basic health problems of our society.

Conclusion

The AHCU is very reliable and efficient machine for monitoring patients to provide them front-desk monitoring, providing prescription and medicines for up to three days. The AHCU take very less time to examine a patient, performing tests and providing him/her medicines. Our Automatic Health Care Unit (AHCU) has the facility of on hand testing for free, prescription for medicines, providing medicine for up to three days and disclaimer to visit nearest doctor or hospital in order to make sure that there is no risk to the life of the patient.

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Conflict of Interest

There is no conflict of interest among the authors.

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